

## CLAIMS

1. A CO-selective catalyst comprising:  
a catalytic material, wherein said catalytic material is selected from the group consisting of Pt, Pd, Rh, Ir, Os, Ru, Ta, Zr, Y, Ce, Ni, Cu, and oxides, alloys, compounds, and combinations comprising at least one of the foregoing;  
a modifying agent selected from the group consisting of Pb, Bi, Ge, Si, Sb, As, P, and alloys, nitrates, sulfides, chlorides, and modifying agents, and combinations comprising at least one of the foregoing, wherein said modifying agent is present in an amount of about 2 to about 25 atomic percent, wherein atomic percent is the number of atoms of said modifying agent present in 100 surface atoms of said catalytic material; and  
a support.
2. The CO-selective catalyst of Claim 1, wherein said catalytic material is selected from the group consisting of Pt, Pd, Rh, Ir, and oxides, alloys, compounds, and combinations comprising at least one of the foregoing catalytic materials.
3. The CO-selective catalyst of Claim 1, wherein said modifying agent comprises Pb.
4. The CO-selective catalyst of Claim 1, wherein said CO-selective catalyst comprises about 8 to about 15 atomic percent of said modifying agent.
5. The CO-selective catalyst of Claim 1, wherein said support is selected from the group consisting of alumina, titania, zirconia, and combinations comprising at least one of the foregoing supports.
6. The CO-selective catalyst of Claim 1, further comprising about 0.5 to about 5.0 wt% of said catalytic material, based upon a total weight of said catalytic material, said modifying agent, and said support.
7. The CO-selective catalyst of Claim 6, further comprising about 1.0 to about 3.5 wt% of said catalytic material.

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8. The CO-selective catalyst of Claim 7, further comprising about 1.8 to about 2.5 wt% of said catalytic material.

9. The CO-selective catalyst of Claim 1, further comprising about 0.01 to about 0.5 wt% of said modifying agent, based upon a total weight of said CO-selective catalyst.

10. The CO-selective catalyst of Claim 9, further comprising about 0.05 to about 0.30 wt% of said modifying agent.

11. The CO-selective catalyst of Claim 10, further comprising about 0.10 to about 0.20 wt% of said modifying agent.

12. A method for forming a CO-selective catalyst comprising:  
combining a catalytic material and a support with about 2 to about 25 atomic percent of a modifying agent, based on the total surface atoms of said catalytic material, to form a modified catalyst-containing support wherein:

said catalytic material is selected from the group consisting of Pt, Pd, Rh, Ir, Os, Ru, Ta, Zr, Y, Ce, Ni, Cu, and oxides, alloys, compounds, and combinations comprising at least one of the foregoing catalytic materials;

said modifying agent is selected from the group consisting of Pb, Bi, Ge, Si, Sb, As, P, and combinations comprising at least one of the foregoing modifying agents; and

said support is selected from the group consisting of alumina, zirconia, titania, and combinations comprising at least one of the foregoing supports; and  
disposing said modified catalyst-containing support on or into a substrate.

13. The method of Claim 12, wherein said catalytic material is present in an amount of about 0.5 to about 5.0 wt%, based upon a total weight of said modified catalyst-containing support.

14. The method of Claim 13, wherein said catalytic material is present in an amount of about 1.0 to about 3.5 wt%.

15. The method of Claim 14, wherein said catalytic material is present in an amount of about 1.8 to about 2.5 wt%.

16. The method of Claim 12, wherein said modifying agent is present in an amount of about 0.01 to about 0.5 wt%, based upon a total weight of said modified catalyst-containing support.

17. The method of Claim 16, wherein said modifying agent is present in an amount of about 0.05 to about 0.30 wt%.

18. The method of Claim 17, wherein said modifying agent is present in an amount of about 0.10 to about 0.20 wt%.

19. The method of Claim 12, wherein combining said catalytic material, said support and said modifying agent further comprises:  
 combining said catalytic material with said support to form a mixture;  
 heating said mixture in a chamber comprising said modifying agent; and  
 introducing said modifying agent to said mixture.

20. The method of Claim 19, wherein said catalytic material is selected from the group consisting of Pt, Pd, Rh, Ir, and oxides, alloys, compounds, and combinations comprising at least one of the foregoing catalytic materials.

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21. The method of Claim 19, wherein said modifying agent comprises Pb, Bi, Ge, Si, Sb, As, P, and combinations comprising at least one of the foregoing, and metals, alloys, nitrates, sulfides, and chlorides of at least one of said foregoing modifying agents.

22. The method of Claim 21, wherein said modifying agent comprises Pb.

23. The method of Claim 12, wherein combining said catalytic material, said support and said modifying agent further comprises:

forming a catalytic material solution of said catalytic material;

forming a modifying agent solution of said modifying agent, wherein said modifying agent solution and said catalytic material solution comprise a solvent individually selected from the group consisting of nitrates, sulfides, chlorides, and combinations comprising at least one of the foregoing second solvents;

forming a support slurry; and

combining said catalytic material solution, said modifying agent solution, and said support slurry to form a second slurry.

24. The method of Claim 23, wherein said support slurry comprises alumina.

25. The method of Claim 24, wherein said support slurry comprises about 38 to about 40 wt% aluminum, based on a total weight of said support slurry.

26. The method of Claim 23, wherein said catalytic material solution comprises platinum nitrate, wherein said platinum nitrate comprises about 15 to about 19 wt% platinum, based on the weight of said platinum contained in said catalytic material solution.

27. The method of Claim 23, wherein said modifying agent solution comprises lead nitrate, wherein said lead nitrate comprises about 60 to about 65 wt% lead, based on the weight of said lead contained in said modifying agent solution.

28. The method of Claim 23, further comprising adjusting a pH of said second slurry to about 3.0 to about 3.5.

29. A fuel cell system comprising:

a fuel reformer;

a CO-selective reformer in fluid communication with said fuel reformer, wherein said CO-selective reformer comprises a housing disposed around a substrate comprising a CO-selective catalyst comprising: a catalytic material, wherein said catalytic material selected from the group consisting of comprises Pt, Pd, Rh, Ir, Os, Ru, Ta, Zr, Y, Ce, Ni, Cu, and oxides, alloys, compounds, and combinations comprising at least one of the foregoing, a modifying agent selected from the group consisting of Pb, Bi, Ge, Si, Sb, As, P, and combinations comprising at least one of the foregoing, wherein said modifying agent is present in an amount of about 2 to about 25 atomic percent based on the total surface atoms of said catalytic material, and a support; and

a fuel cell in fluid communication with said CO-selective reformer.

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